

## 4.2.4. FLIR Slew Limits

### 4.2.4.1. Purpose

The purpose of this test is to measure the vertical and horizontal slew limits of the FLIR and the utility of these limits for providing a target display while the aircraft maneuvers to the target and for searching a sufficiently wide area around the aircraft ground track and attitude.

### 4.2.4.2. General

The IFOV defines the area of the scene that the FLIR can display at a given instant. There will be some physical limits over which the gimballed ball containing the FLIR reticle can be slewed, thus limiting the search volume of the FLIR and the angles from the fuselage reference line that a scene can be displayed. These limits are usually defined both vertically and horizontally and for tactical aircraft are typically 100' left and right, 20' up and 90' down as measured from the fuselage reference line. A final constraint on the scene's volume that can be displayed is the area masked by the aircraft fuselage and other obstructions. This last constraint will be evaluated during the field of regard test to follow. The symmetry of the display, that is, the correct alignment of the physical limits with the fuselage reference line, will be determined during the FLIR pointing accuracy test. The slew limit tests will provide only the total angle between the left and right and up and down slew limits.

### 4.2.4.3. Instrumentation

A protractor, plumb bob, cord, tape measure, level and data cards are required for this test. A voice recorder is optional.

### 4.2.4.4. Data Required

While on the ground, record the angle from the position of the display crosshairs with the FLIR slewed completely to the left to the position of the crosshairs with the FLIR slewed completely to the right. Record the angle from the position of the display crosshairs with the FLIR slewed fully up and the angle of the crosshairs from vertical with the FLIR slewed fully down. Make qualitative comments concerning the utility of the slew angle limits while performing mission relatable evasive maneuvers and attacks.

### 4.2.4.5. Procedure

Park the airplane with the fuselage reference line perpendicular to a wall. Turn on and time out the FLIR. Use the plumb bob to find and mark a point on the ground directly below the swivel point of the reticle. Slew the FLIR fully left. Have an assistant adjust the position of the plumb bob until it corresponds with the vertical crosshair of the FLIR. Mark the point where the plumb bob reaches the ground. Note that close communications are required between the evaluator in the aircraft and the assistant. Repeat for the right slew limit. Stretch a cord from the mark on the ground below the FLIR to the left mark and to the right mark. Use the protractor to measure the angle between the two cords. Next, slew the FLIR fully down and have the assistant mark the intersection of the crosshairs on the ground. Stretch a cord from the direction of the center of the FLIR reticle swivel point to the point on the ground. Have the assistant use the level to adjust the protractor perpendicular to local vertical and measure the angle from the string to local vertical (down). Repeat for the upper slew limit point, marking the point on the wall ahead of the aircraft and using the level, protractor and string to measure the angle from horizontal as defined by the level.

While airborne, perform mission relatable attacks against a simulated ground target, jinking as would be required during an attack and maneuvering to perform a weapons delivery. Note if the FLIR slew limits are reached while slewing the FLIR to maintain contact with the target. Repeat for a variety of maneuvering weapons deliveries.

### 4.2.4.6. Data Analysis and Presentation

Add the upper and lower slew limit measurements to obtain the vertical slew limits. Relate the slew limits to the necessity to jink inbound to the target to avoid enemy defenses as well as to the requirement to maneuver during various weapon deliveries such as iron bomb lofts and to the necessity to maintain FLIR contact with the target during the deliveries.

### 4.2.4.7. Data Cards

Sample data cards are presented as card 60.

CARD NUMBER \_\_\_\_

## FLIR SLEW LIMITS (GROUND TEST)

[POSITION THE AIRCRAFT WITH THE FUSELAGE REFERENCE LINE PERPENDICULAR TO A WALL. HAVE AN ASSISTANT USE A PLUMB BOB TO MARK DIRECTLY BELOW THE CENTER OF THE RETICLE BALL SWIVEL POINT, THE POINT ON THE GROUND BELOW THE LEFT AND RIGHT SLEW LIMITS AND THE POINT ON THE WALL AND FLOOR FOR THE UPPER AND LOWER SLEW LIMITS. USE CORDS TO MEASURE THE DIFFERENCE BETWEEN THE LEFT/RIGHT LIMITS AND THE ANGLES FROM LOCAL VERTICAL FOR THE UPPER AND LOWER LIMITS.]

LEFT TO RIGHT ANGLE \_\_\_\_

UPPER LIMIT ANGLE \_\_\_\_

LOWER LIMIT ANGLE \_\_\_\_

CARD NUMBER \_\_\_\_\_ TIME \_\_\_\_\_ PRIORITY L/M/H

FLIR SLEW LIMITS (AIRBORNE TEST)

[DESCEND TO \_\_\_\_\_ FEET AGL AND SET MACH=\_\_\_\_. ACQUIRE THE \_\_\_\_\_ TARGET AND HEAD INBOUND, SELECTING THE NFOV AND UPDATING THE CURSOR PLACEMENT AS NECESSARY. PERFORM MISSION RELATABLE JINKING INBOUND AND THEN PERFORM A \_\_\_\_\_ DELIVERY. NOTE IF THE FLIR REACHES THE SLEW LIMITS. REPEAT FOR THE \_\_\_\_\_ AND \_\_\_\_\_ DELIVERIES.]

TYPE DELIVERY \_\_\_\_\_

POINT IN DELIVERY WHERE THE LIMITS ARE REACHED:

DISPLAYED FLIR POSITION

VERTICAL \_\_\_\_\_

HORIZONTAL \_\_\_\_\_

TYPE DELIVERY \_\_\_\_\_

POINT IN DELIVERY WHERE LIMITS REACHED:

DISPLAYED FLIR POSITION

VERTICAL \_\_\_\_\_

HORIZONTAL \_\_\_\_\_

## 4.2.5. Slew Rates

### 4.2.5.1. Purpose

The purpose of this test is to determine the vertical and horizontal maximum slew rates of the FLIR and to evaluate the effects these rates have upon the utility of the FLIR for quickly pointing to the direction of a target and then maintaining an orientation towards the target as the host aircraft maneuvers or flies in close proximity to the target.

### 4.2.5.2. General

The FLIR slew rates are important for three reasons. First, the operator will want to rapidly point the FLIR in the direction of targets of opportunity or towards objects that catch his or her attention. Next, as the aircraft maneuvers towards its maximum limits, the angles from the fuselage reference line to the target may change rapidly. The FLIR will have to slew rapidly to keep up with the aircraft rates. Finally, as the aircraft approaches the target, the angles from the fuselage reference line to the target will have to eventually change, unless the pilot flies a collision course to the target. Many types of ordnance require targeting data even as the aircraft passes the target and leaves the area. Even for unguided ordnance, the operator may want to continue viewing the target after an overflight to assess the damage. For a given aircraft groundspeed, the closer the aircraft passes to the target, the higher the slew rates that will be required to keep the FLIR aligned onto the target.

### 4.2.5.3. Instrumentation

A stop watch and data cards are required for this test. A voice recorder is optional.

### 4.2.5.4. Data Required

Record the time for the FLIR turret to slew from full left to full right and full right to full left. Record the time to slew from full up to full down and full down to full up. List qualitative comments concerning the utility of the FLIR for quickly slewing from a target near one slew angular limit to the opposite slew angular limit. Make comments concerning the utility of the slew rate limits as the aircraft performs evasive maneuvers within the aircraft angular slew limits for maintaining alignment with the

target. Record comments concerning the utility of the slew rate limits as the aircraft flies over the target at mission relatable weapons release altitudes and performs post release maneuvers, for maintaining the FLIR alignment with the target.

### 4.2.5.5. Procedure

Measure the slew angular limits as described earlier. While on the ground, slew the FLIR to a full left angular limit. Slew to a full right angular limit as quickly as possible using the stop watch to measure the time. Repeat in the opposite direction. Slew the FLIR to the full down position and measure the time required to slew to a full up position. Repeat for a full up to a full down position. Close coordination will be required between the operator and an assistant if the operator is unable to accurately observe the FLIR pod slew.

During mission relatable attacks, perform evasive maneuvers inbound to the target. Evaluate the utility of the FLIR slew rates for maintaining orientation over the target position. Attempt the test first in a geostable mode and if problems are noted repeat in a manual fuselage referenced mode. Overfly the target at a mission relatable minimum altitude for weapons delivery and then perform mission relatable post-flight maneuvers. Evaluate the utility of the FLIR slew rates for maintaining alignment with the target for post-release weapons guidance and post-attack damage assessment. Perform the test first in a geostable mode and if problems are noted perform the test in a fuselage referenced manual mode. Repeat the attack using different attack modes as time allows.

### 4.2.5.6. Data Analysis and Presentation

Divide the horizontal slew angular limits by the number of seconds required to slew from left to right and from right to left to get the slew rate in degrees per second. The two measurements should be fairly close or a problem in the slewing mechanization may be indicated. Repeat for the upper and lower angles. There might be a slight difference in these two rates due to the effects of gravity, depending upon the slewing mechanism. Note that these are average slew rates and may vary at different points during slewing; however, in most situations where large slew rates are operationally required,